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ABSTRACT

A sentence demonstration task was used to examine the information processing skills of 14 normal and 14 learning disabled college students. The effects of sentence meaningfulness (meaningful vs. nonsense), sentence length (two vs. four vs. six vs. eight items), and presentation mode (words vs. logographs) were evaluated. A Population Membership by Sentence Length interaction was detected and indicated that performance differences between the populations, favoring the normal Ss, emerged on long sentences. Effects of sentence type and presentation mode were similar in the two populations. Differences in short term memory processing were hypothesized to account for the population differences. (Author)

Sentence Demonstration Ability in Learning Disabled and Normal College Students: Analysis of Presentation Mode, Sentence Length, and Meaningfulness Effects

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Abstract

A sentence demonstration task was used to examine the information processing skills of normal and learning disabled college students. The effects of sentence meaningfulness (meaningful vs. nonsense), sentence length (2 vs. 4 vs. 6 vs. 8 items), and presentation mode (words vs. logographs) were evaluated. A Population Membership by Sentence Length interaction was detected and indicated that performance differences between the populations, favoring the normal subjects, emerged on long sentences. The effects of sentence type and presentation mode were similar in the two populations. Differences in short-term memory processing were hypothesized to account for the population differences.

Sentence Demonstration Ability in Learning Disabled and Normal College Students: Analysis of Presentation Mode, Sentence Length, and Meaningfulness Effects

Research has begun to examine the prose recall skills of learning disabled adults (see Worden & Nakamura, 1982; Worden, Malmgren, & Gabourie, 1982). The theoretical framework that guides this work is the suggestion that limitations in short-term or working memory may underlie deficits in long-term recall of prose materials. For example, Perfetti and Lesgold (1978) have suggested that a reduced speed of processing in short-term memory may cause encoding to lag behind the input. As sentences are read into short-term memory, disabled learners take longer to retrieve verbal codes for individual words. This delay, in turn, impairs their ability to process information about larger units (clauses, sentences) for storage in long-term memory.

A sentence demonstration task was used in the present study to investigate potential short-term memory processing differences which distinguish learning disabled from normal college students. In this task, participants are presented with a sentence to read aloud such as "Sit on the pillow." Props are provided and participants are subsequently asked to demonstrate the meaning of the sentence from memory. Sentences used in the present study varied in length between 2 to 8 words. Because of the hypothesized short-term memory processing differences between learning disabled and normal college students, differences between the two groups in sentence demonstration performance were expected to emerge on long sentences (e.g., six and eight word sentences), but not on short sentences (e.g., 2 or 4 words).

Generally speaking, research has suggested that short-term memory processing differences observed between learning disabled and normal colllege students are larger with word-like stimuli than with nonlinguistic stimuli such as digits (see Worden, in press). Therefore, two kinds of word-like stimuli were selected for use in the present study: Printed English words and logographs (whole word symbols). The logograph stimuli differ from printed English words in at least three important ways:

1. Logographs should be equally novel to both groups of subjects; while normal subjects probably have had greater experience with reading printed English words (Jackson, 1980);
2. Logographs do not permit phonetic decoding in contrast to printed English words (Glushko, 1980);
3. Logographs are visually wholistic in contrast to printed English words which consist of individual letters.

Thus to the extent that words are difficult to process in short-term memory--because they are less frequently experienced in reading by disabled learners, they may require phonetic decoding, and they are constructed out of combinations of individual letters--a Population by Presentation Mode interaction was anticipated in this study. That is, performance differences between the groups should be largest under printed English word orthography in comparison to logographs.

Finally, provisions were made in the study to manipulate the meaningfulness of the sentences presented to participants. The comparison of meaningful versus nonsense sentences was included to evaluate the degree to which learning disabled college students may differ from normal college students in their ability to use the semantic content of the sentence to facilitate encoding.

Method

Design and Subjects

The design of the experiment consisted of a 2 by 2 by 4 by 2 by 2 factorial with the between subjects factor of population (normal vs. learning disabled) and the within subjects factors of meaningfulness (meaningful vs. nonsense), sentence length (2 vs. 4 vs. 6 vs. 8 items), presentation mode (words vs. logographs), and trial. Fourteen normal college students from California State University at Fullerton and 14 learning disabled college students selected from the Santa Ana Community College Learning Disabilities Center participated in the study. The learning disabled subjects had WAIS scores above 95. Reading level estimates provided by the Peabody Individual Achievement Test (PIAT) indicated that the normal college students were reading at twelfth grade or college level, whereas the learning disabled students were generally reading at the sixth grade level.

Materials and Procedures

Subjects were tested individually. At the beginning of each session subjects were given ten minutes to study a set of 14 logographs. The logographs represented English word equivalents of nouns (the boy, the girl, the chair, the box, the pillow, and the table), verbs (sit, stand, and put), and prepositions (on, under, beside, and behind). These logographs were drawn on 5 x 8 inch cards and their word equivalents written on the reverse side. During the ten minute study period, subjects were told to learn the word equivalents for each logograph. Subsequently, subjects were tested by a paired-associate anticipation method until they had reached a criterion of two errorless trials. During this phase of the

study, normal college students required fewer trials ($\bar{X}$ = 2.29) to reach criterion than learning disabled college students ($\bar{X}$ = 4.26), $p < .05$.

Following logograph learning, the sentence demonstration task was administered. Subjects were provided with toy props (a pillow, a table, etc.) to act out the sentences. The sentences were drawn/printed on 5 x 8 inch cards and presented to subjects manually. Subjects were asked to read aloud the sentence presented on the card and then, to demonstrate the meaning of the sentence. For example, the logograph sentence " " stands for "sit the boy on the table." Subjects would read this sentence and then, pick up the toy boy doll and position it in a sitting position on the prop table. Actions and object identifications made by subjects were recorded for subsequent analysis.

Each subject was presented with eight sentences at each sentence length. Furthermore, sentences were blocked into two trial sets of four sentences each. The four sentences within a trial set represented the factorial combination of 2 levels of meaningfulness by 2 levels of presentation mode. Nonsense sentences were generated by scrambling the word-order of the meaningful sentences. Across subjects appropriate counterbalancing of these within subject variables was provided.

Results and Discussion

The dependent variable selected for analysis was the number of items participants successfully referenced in their demonstration of each sentence. Table 1 presents the means for these recall scores as a function

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Insert Table 1 about here

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of the experimental conditions. An analysis of variance was performed and indicated that the performance of normal students ($\bar{Y}$ = 4.51) was superior to the learning disabled students ($\bar{Y}$ = 3.41), F (1,36) = 13.79; meaningful sentences ($\bar{Y}$ = 4.30) were associated with higher recall scores than nonsense sentences ($\bar{Y}$ = 3.60), F (1,36) = 86.39; and recall scores increased with sentence length. F (3,78) = 113.39, all ps < .001.

Of major interest, however, were the predicted interactions with the factor of population. Consistent with the first prediction that population differences in sentence recall would emerge only at the longer sentence lengths, a significant Population by Sentence Length interaction was detected, F (3,78) = 12.12, p < .001. The mean differences in recall scores, favoring the normal subjects at sentence lengths two, four, six, and eight were +.02, +.30, +1.29, and +2.51, respectively. Thus, both learning disabled and normal college students can successfully process sentences. However, differences will emerge when the task demands, for example the reading of long sentences, exceed the operational limits of the learning disabled students' working memory.

The second major issue addressed in this study concerned the extent to which words and logographs would show different encoding effects with learning disabled and normal college students. None of the critical interactions involving the factors of population and presentation mode were significant (ps > .05). This suggests that differences between printed English word and logograph stimuli, such as novelty, phonetic decoding, and letter segmentation, are not factors which differentially affect short-term memory processes of learning disabled and normal students.

A final issue concerrned the effects of sentence meaningfulness on

participants' recall performance. No interactions with the factor of population were observed ($ps > .05$) indicating that both groups can take advantage of the semantic content of sentences to facilitate their encoding. However, it is interesting to note that a Meaningfulness by Sentence Length interaction was observed, $F(3,78) = 57.28$, $p < .001$, indicating that the superior recall associated with meaningful sentences increased with longer sentences. This interaction was qualified by the three-way interaction of Meaningfulness by Sentence Length by Presentation Mode, $F(3,78) = 3.18$, $p < .02$. Descriptively, this interaction suggests that the advantage associated with meaningful sentences at the longer sentence lengths was larger under printed English word presentation than logograph presentation.

In summary, the results of this study extend our knowledge about short-term memory deficits in learning disabilities in several ways. First, learning disabled subjects performed significantly worse than normal subjects, but only at longer sentence lengths. This finding extends a similar finding by Cohen and Netley (1978) that learning disabled children performed dramatically worse than normal children on a probe serial recall task involving lists which exceeded their short-term memory spans. Our finding of a similar effect with adults broadens Cohen and Netley's conclusion that the inability of the memory system to cope with an overload is a central feature in learning disabilities: we now know that this problem is not limited to learning-disabled children, but rather persists into adulthood.

A second important finding was that performance was equivalent for words versus logographs. This suggests that decoding difficulties reside

in the assignment of meaning to visual symbols, regardless of their orthography. In particular, phoneme segmentation is not implicated as a significant factor in the learning disabilities of adults because logographs are assigned meanings wholistically, without recourse to individual-letter pronunciation. Finally, meaningfulness did not affect the ability groups differently. That is, the differences in performance were of the same magnitude for meaningful versus nonmeaningful sentences, thereby ruling out any differential integration of the overall meaning of sentences to aid memory by learning-disabled and normal college students.

In conclusion, the results support the notion of a short-term memory bottleneck in learning disabilities that simply reduces the amount of word-like information in memory, regardless of orthography and overall effects of meaningfulness. The deficit could be due to a reduced speed of processing (see Perfetti & Lesgold, 1978), or to a tendency to engage in less rehearsal or elaborative coding (see Torgesen, 1977) by learning disabled persons. Further research will be needed before we can decide which explanation best accounts for the short-term memory processing deficits of learning-disabled individuals. A promising approach will be to evaluate the compensatory effects of memory strategy instruction with learning-disabled persons (see Worden, in press).

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Table 1

Mean Number of Sentence Items Demonstrated by Normal and Learning Disabled College Students as a Function of Sentence Meaningfulness, Sentence Length, and Presentation Mode

		Population							
		Normal				Learning Disabled			
Sentence	Presentation	Sentence Length							
Meaningfulness	Mode	2	4	6	8	2	4	6	8
Meaningful	Logographs	2.00	4.00	5.93	7.82	1.90	3.64	4.47	5.11
	Words	2.00	4.00	5.93	7.75	1.97	3.72	4.64	5.30
Nonsense	Logographs	1.93	3.29	5.29	6.60	1.86	3.11	3.68	3.75
	Words	1.65	2.93	5.25	5.70	1.75	2.54	4.47	3.71